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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference p200301688 wo		FOR FURTHER ACTION		See Form PCT/PEA/416
International application No. PCT/DK2004/000707		International filing date (day/month/year) 14.10.2004		Priority date (day/month/year) 14.10.2003
International Patent Classification (IPC) or national classification and IPC H03F3/187, H03F3/181, H03F1/34, H04R19/01, H04R19/04				
Applicant AUDIOASICS AS ET AL.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 6 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 15.08.2005		Date of completion of this report 16.01.2006		
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016		Authorized Officer Fedi, G Telephone No. +31 70 340-2280		



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/DK2004/000707

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-31 as originally filed

Claims, Numbers

1-31 filed with telefax on 22.12.2005

Drawings, Sheets

1/18-18/18 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box-(Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT
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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-31
	No: Claims	
Inventive step (IS)	Yes: Claims	1-31
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-31
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. The document WO 2005/076466 was not cited in the international search report and has been filed by the same applicant of the present application. A copy of the document is appended hereto.

Care should be taken by the applicant, when entering in the regional phase, that the subject matter of the present application is not overlapping with the one of said document WO 2005/076466.

2. The document US-A-5 357 214, which is regarded as being the closest prior art to the subject-matter of independent claim 1, discloses:

Claim 1: A microphone preamplifier, comprising a differential input stage with a first and a second input terminal and an output stage with an output terminal; where the microphone preamplifier is integrated on a semiconductor substrate; and a feedback circuit, with a low-pass frequency transfer function, coupled between the output terminal and the first input terminal to provide a feedback signal input to the first input terminal; where the second input terminal provides an input for a microphone signal.

The subject-matter of claim 1 differs from the microphone preamplifier of document US-A-5 357 214 in that the following additional feature is present: where the microphone signal and the feedback signal are coupled separately to respective ones of the first input and the second input.

The subject-matter of independent claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as the provision of a microphone preamplifier with better accuracy and low distortion, which is well known in the field of microphone preamplifier design.

However the solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) because it uses a low-pass

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(SEPARATE SHEET)**

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filtering feedback circuitry which is not dependent on the microphone signal input, therefore the input impedance of said microphone preamplifier is not dependent on said feedback and the microphone signal is not loaded by said low pass filtering feedback circuitry.

The subject matter of claim 1 is based on the description as filed and the set of claims 2-31 is dependent on claim 1 and as such also meets the requirements of the PCT with respect to novelty and inventive step.

CLAIMS

1. A microphone preamplifier, comprising
a differential input stage with a first and a second input terminal and an
output stage with an output terminal; where the microphone preamplifier is
5 integrated on a semiconductor substrate; and
a feedback circuit, with a low-pass frequency transfer function, coupled
between the output terminal and the first input terminal to provide a feedback
signal input to the first input terminal;
where the second input terminal provides an input for a microphone signal,
10 and where the microphone signal and the feedback signal are coupled
separately to respective ones of the first input and the second input.
2. A microphone preamplifier according to claim 1, wherein the differential
15 input stage comprises an inverting input and a non-inverting input, wherein
the non-inverting input is arranged to receive the microphone signal, and the
inverting input is arranged to receive a feedback signal provided by the feed-
back circuit.
- 20 3. A microphone preamplifier according to claim 1 or 2, wherein the feedback
circuit is a filter with a transfer function, in the frequency domain, with a zero
and a pole; wherein the zero is located at a higher frequency than the pole.
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- 25 4. A microphone preamplifier according to any of claims 1 to 3, wherein the
preamplifier has a transfer function, in the frequency domain, with a zero and
a pole; wherein the pole is located in the range 0.1Hz to 50 Hz or 0.1Hz to
100Hz or 0.1 to 200Hz.
5. A microphone preamplifier according to any of claims 1 to 4, wherein the
30 feedback circuit is a filter which, in the frequency domain, has a relatively

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high gain level below a transition frequency range and a relatively low gain level above the transition frequency range.

5 6. A microphone preamplifier according to claim 5, wherein the transition frequency range is located below a frequency of about 100 Hz.

7. A microphone preamplifier according to claim 5, wherein the transition frequency range is located below a frequency of 40 Hz.

10 8. A microphone preamplifier according to any of claims 1 to 7, wherein the feedback circuit is an active filter.

9. A microphone preamplifier according to any of claims 1 to 7, wherein the feedback circuit is a passive filter.

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10. A microphone preamplifier according to any of claims 1 to 9, wherein the feedback circuit is configured with an active device which provides an ohmic impedance across a two-port circuit.

20 10. A microphone preamplifier according to any of claims 1 to 11, wherein the feedback circuit comprises a configuration with a first and a second active device and a current source, where the devices comprise a respective gate terminal, a source terminal and a drain terminal, and where the gate terminals are interconnected at a node connected to the current source and
25 the drain terminal of the first device, and where the source terminals are interconnected, to provide the second device in a state where an ohmic resistance is provided between its drain and source terminal.

30 11. A microphone preamplifier according to any of claims 1 to 12, wherein the feedback circuit comprises a filter with an input port connected to a series connection of a first and second resistor which forms a resistor node at their

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interconnection, and connected to a series connection of a first and second capacitor which forms a capacitor node at their interconnection; and an output port at the capacitor node; wherein the resistor node and capacitor node are interconnected by an active device which provides an ohmic impedance across a two-port circuit.

12. A microphone preamplifier according to any of claims 1 to 11, wherein the feedback circuit comprises a source providing a DC offset.
- 10 13. A microphone preamplifier according to any of claims 1 to 12, wherein the feedback circuit comprises a filter with a source that provides a DC offset.
14. A microphone preamplifier according to any of claims 1 to 13, wherein a DC offset is provided at the first input of the preamplifier by a circuit
- 15 configuration comprising a current source coupled, at the circuit node of the first input of the preamplifier, to an active device which provides an ohmic impedance across a two-port circuit.
15. A microphone preamplifier according to claim 14, wherein the active
- 20 device constitutes a second device in a configuration with a first and the second active device and a current source, where the devices comprise a respective gate terminal, a source terminal and a drain terminal, and where the gate terminals are interconnected at a node connected to the current
-
- 25 source and the drain terminal of the first device, and where the source terminals are interconnected, to provide the second device in a state where an ohmic resistance is provided between its drain and source terminal.
16. A microphone preamplifier according to claim 1, wherein the differential input stage comprises a first and second current path for the respective
- 30 differential inputs, and wherein a DC offset is provided by establishing

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different DC currents through the first and second current path of the differential input stage.

17. A microphone preamplifier according to any of claims 1 to 16, wherein the preamplifier is configured to receive the microphone signal via an input bias element which has relatively high ohmic impedance when the microphone signal is relatively small in magnitude and relatively low ohmic impedance when the microphone signal is relatively high in magnitude.

18. A microphone preamplifier according to claim 17, wherein the bias element is configured by two cross-coupled diodes.

19. A microphone preamplifier according to claim 17, wherein the bias element is configured by two cross-coupled bipolar transistors.

20. A microphone preamplifier according to claim 17, wherein the bias element is configured by two cross-coupled Metal Oxide Semiconductor, MOS, devices.

21. A microphone preamplifier according to any of claims 1 to 20, wherein the preamplifier is a differential amplifier which is configured to convert an input signal into a common mode signal for low frequencies and into a differential signal for audio frequencies.

22. A microphone preamplifier according to any of claims 1 to 21, wherein a differential amplifier is configured as an instrumentation type amplifier with two inputs and a first and a second output, wherein the first and second input is arranged to receive a microphone signal, but wherein the inputs are coupled to receive the microphone signals substantially in phase at relatively low frequencies and substantially out of phase at relatively high frequencies.

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23. A microphone preamplifier according to any of claims 1 to 22, wherein a differential amplifier is configured to provide frequencies below an audio band as common mode signals and audio band signals as differential mode signals.

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24. A microphone preamplifier according to any of claims 1 to 23, wherein a phase shifter is coupled between inputs of the differential amplifier.

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25. A microphone preamplifier according to any of claims 1 to 24, wherein a phase shifter is cross coupled between an output of one side of the differential amplifier and an input of the opposite side of the differential amplifier.

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26. A microphone preamplifier according to any of claims 21 to 25, wherein a phase shifter is coupled between a signal node, substantially in phase with an input signal to the amplifier, and an input terminal of an opposite side of the differential amplifier.

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27. A microphone according to any of claims 1 to 26, comprising a voltage pump integrated on the semiconductor substrate.

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28. A microphone according to any of claims 1 to 27, comprising an electret microphone configured to provide a microphone signal, responsive to a sound pressure on the electret microphone, to the microphone preamplifier.

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29. A microphone module according to any of claims 1 to 28, wherein the electret microphone is mounted inside a space formed by a cartridge, and wherein the microphone preamplifier is integrated within the microphone module.

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30. A microphone preamplifier according to any of claims 1 to 29, comprising a MEMS microphone member to provide a microphone signal, responsive to a sound pressure on the MEMS microphone, to the microphone preamplifier.

- 5 31. A microphone preamplifier according to claim 29, wherein the MEMS microphone member and the microphone preamplifier are integrated on a semiconductor substrate.

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